

WHAT IS CLAIMED IS:

1. A composition for self healing of cracks generated in underfill material between an I/C chip and a circuitized substrate, comprising;
said underfill material having a cured epoxy base,
5 a plurality of capsules dispersed in said epoxy base,
each of said capsules being a curable thermosetting adhesive encapsulated in a rupturable shell to disperse said thermosetting adhesive in a crack formed in said epoxy base when said shell ruptures,
each capsule being less than about 25 microns in diameter, and
10 a curing agent that will react with or cause a reaction of said thermosetting adhesive on contact to form a cured adhesive dispersed in said crack in said epoxy base.
2. The invention as defined in claim 1 wherein said thermosetting adhesive is
15 dicyclopentadiene.
3. The invention as defined in claim 1 wherein said shell is urea-formaldehyde.
- 20 4. The invention as defined in claim 1 wherein said curing agent is a ruthenium base catalyst.

5. The invention as defined in claim 1 wherein there is between about 5% and about 20% by weight of said capsules with respect to said underfill material

6. The invention as defined in claim 5 wherein there is about 10% by weight of said capsules.

7. The invention as defined in claim 1 wherein there is an effective amount up to about 5% by weight of said curing agent.

8. A method of self-healing cracks that form in underfill material between an I/C chip and a circuitized substrate, wherein said underfill material has a cured epoxy base, comprising the steps of:

providing a plurality of capsules dispersed in said epoxy base,

each of said capsules being a curable thermosetting adhesive encapsulated in a rupturable shell to disperse said thermosetting adhesive in a crack formed in said epoxy base when said shell ruptures,

each capsule being less than about 25 microns in diameter,

a curing agent that will react with or cause a reaction of said thermosetting adhesive on contact to form a cured adhesive dispersed in said crack in said epoxy base,

said shell rupturing when encountering said crack being propagated in said underfill material, and at least partially filling said crack with said adhesive, and curing said adhesive with said curing agent to bond the edges of said crack together.

9. The invention as defined in claim 8 wherein said thermosetting adhesive is dicyclopentadiene.

10. The invention as defined in claim 8 wherein said shell is urea-
5 formaldehyde.

11. The invention as defined in claim 8 wherein said curing agent is a ruthenium base catalyst.

10 12. The invention as defined in claim 8 wherein there is between about 5% and about 20% by weight of said capsules with respect to said underfill material.

13. The invention as defined in claim 12 wherein there is about 10% by weight of said capsules.

15 14. The invention as defined in claim 8 wherein there is an effective amount, up to about 2.5% by weight of said curing agent, to cure said thermosetting adhesive.

20 15. The invention as defined in claim 1 wherein the diameter of the capsules is about 10 microns or less.

16. The invention as defined in claim 8 wherein the diameter of said capsules is about 10 microns or less.